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Video-based road commentary training improves hazard perception of young drivers in a dual task

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ABSTRACT

This study used a video-based hazard perception dual task to compare the hazard perception skills of young drivers with middle aged, more experienced drivers and to determine if these skills can be improved with video-based road commentary training. The primary task required the participants to detect and verbally identify immediate hazard on video-based traffic scenarios while concurrently performing a secondary tracking task, simulating the steering of real driving. The results showed that the young drivers perceived fewer immediate hazards (mean = 75.2%, n = 24, 19 females) than the more experienced drivers (mean = 87.5%, n = 8, all females), and had longer hazard perception times, but performed better in the secondary tracking task. After the road commentary training, the mean percentage of hazards detected and identified by the young drivers improved to the level of the experienced drivers and was significantly higher than that of an age and driving experience matched control group. The results will be discussed in the context of psychological theories of hazard perception and in relation to road commentary as an evidence-based training intervention that seems to improve many aspects of unsafe driving behaviour in young drivers.

1. Introduction

There is a plethora of research evidence emphasising the increased crash risk of young novice drivers in their first months of solo driving in comparison to any other driving period. The situation in New Zealand is particularly telling, with young drivers being relatively safe during the supervised driving period (normally six months) of the Graduated Driver Licence system (GDLS), but as soon as they drive independently on their restricted license (often as early as 15½ years), their crash risk increases dramatically to about 8 times the risk level of the supervised period. However, it then decreases by about 50% in the following six months (Lewis-Evans and Lukkien, 2007). This might reflect a strong interaction between age and risk factors related to driving experience, both of which are compounded in New Zealand through an early licensing age of 15 years (learner's license).

There is much evidence to suggest that young novice drivers learn basic car handling skills and traffic laws quickly (e.g., Hall and West, 1996) but need much longer to acquire the complex, higher-order perceptual and cognitive skills (Deery, 1999), in particular the skills of hazard perception (Horswill and McKenna, 2004), visual search and attention (Underwood, 2007) and calibration (Kuiken and Twisk, 2001). However, it seems that these skills can be trained effectively and safely off-road (Chapman et al., 2002; Crick and McKenna, 1991; Engström et al., 2003; McKenna et al., 2006; Fisher et al., 2006; Senserrick, 2006).

A particularly important higher-order driving skill is hazard perception, which according to Horswill and McKenna (2004) seems to be the only component of driving skills that has been found to be related to accident involvement. Hazard perception has been defined as being able to 'read the road' (Horswill and McKenna, 2004) or more comprehensively as 'situation awareness' (see also Endsley, 1995) in relation to potentially dangerous situations in the traffic environment (Horswill and McKenna, 2004). Hazard perception skills involve having a continuous and always changing composite representation of current traffic situations. Good hazard perception skills result in a holistic assessment of risk, which combines information from multiple sources, 360° around the car. This allows drivers to anticipate and predict traffic constellations in the near future which will then enable them to plan appropriate courses of action.

It seems plausible, that good hazard perception skills draw substantially on cognitive resources as they are considered to be conscious and effortful processes and are unlikely to become automated (Horswill and McKenna, 2004). In support of this, McKenna and Farrand (1999) found that a secondary workload (a random letter generation task) heavily interfered with hazard perception in novice as well as in experienced drivers. In fact, the interference of

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the additional workload can reduce the hazard perceptions skills of experienced drivers to a level much lower than that of novice drivers (McKenna and Farrand, 1999), indicating that even after many years of driving experience, these skills place high demands on conscious attentional resources. There is much evidence from a number of studies which clearly indicate that more experienced drivers have shorter hazard perception reaction times and respond more frequently to hazards in comparison to novice drivers. However, the reason for this is still a subject of debate (Horswill and McKenna, 2004, for a review).

One explanation for any performance discrepancy between drivers of different ages could be related to less well developed frontal lobe executive functions of the brain (such as goal directed behaviour, visual search, impulse control, divided attention and working memory) in teenage drivers (Lenroot and Giedd, 2006; Dahl and Spear, 2004; Keating, 2007; Isler et al., 2008). For example, those executive functions which control voluntary eye movements may not yet be fully developed in young drivers. Evidence for this comes from studies such as Munoz et al. (1998) and Klein et al. (2005), who found age related performance of young people in voluntary saccadic eye movement tasks which was attributed to delayed maturation of their frontal lobes. This could suggest that young drivers may be disadvantaged in their search behaviour by not being able to move their eyes fast and frequently enough to fixate on all important traffic information. Indeed, research indicates that young and novice drivers fixate longer on irrelevant traffic information and move their eyes less frequently (Mourant and Rockwell, 1972). However, the inefficient eye scanning behaviour of novice drivers may also stem from the fact that they have not encountered a sufficient number of hazardous situations, to allow them to draw on a broad knowledge base, or a mental map that could assist them in determining what to look out for in different traffic situations (see also Horswill and McKenna, 2004; Underwood, 2007).

Underwood (2007) suggested that in novice drivers, the steering task, including changing gears and speed control has not been automated enough to free up the attentional capacities required to enable effective road situation awareness. Other studies have suggested that young, less experienced drivers simply have a response bias when it comes to detecting hazards. A recent study by Wallis and Horswill (2007), using fuzzy signal detection theory, found that trained and experienced drivers applied more liberal criteria and responded to hazards more often and had faster hazard perception reaction times than the young, less experienced drivers. However, replicating the findings of Farrand and McKenna (2001), they found no difference in their ability to discriminate the traffic scenes according to the level of hazardousness. This indicates that compared to experienced drivers, young drivers respond more slowly to hazards (particularly to less hazardous ones) even though they rated the anticipatory cues of the level of the hazards equally. Or in simpler terms, it could indicate that the novice drivers are simply less willing to label traffic scenarios as hazardous and therefore do not appreciate the need to respond, as quickly as experienced drivers do. However, as Horswill and McKenna (2004) pointed out, there is indirect evidence indicating that a response bias alone cannot explain the slower hazard perception reaction time. For example, as outlined earlier, experienced drivers seem to engage in more efficient and effective search of hazards and this should allow them to detect hazards earlier and to respond faster. Also, to date no relationship between drivers' rating of the level of risk in traffic scenarios and their hazard perception reaction time has been found (Horswill and McKenna, 2004), which seems to indicate that perceived risk does not necessarily affect the response bias in hazard perception.

Taking this research evidence together, it seems reasonable to propose that while novice drivers might be able to rate hazardous scenarios in the same way as experienced drivers, they do not experience the same urgency to search and respond to them in real driving as the experienced drivers. Aside from having insufficient driving experience to develop efficient road search strategies (see Underwood, 2007), it could be that novice drivers simply consider the steering task as a higher priority than searching for hazards, thereby explaining some of the unsafe response bias outlined above. There is some evidence for this suggestion as research using secondary tasks indicates that drivers do prioritise different workloads which could then impact on their driving performance. For example, Cnossen et al. (2004) found that drivers attended to a navigational secondary task rather than to their performance on a memory task indicating that drivers prioritise their task goals. This reinforces the finding of Farrand and McKenna (2001), cited in Horswill and McKenna (2004), that instructions on how to perform the hazard perception task influenced the rate of responding, indicating that any response bias in hazard perception could possibly be subject to relative simple behavioural modification.

Most hazard perception studies used video-based traffic scenarios, filmed from the perspective of a driver with the participants required to respond whenever they detected a hazard (Horswill and McKenna, 2004, for a review). These tests allow the drivers to focus their full visual attention on finding hazards in the front view traffic scene and also provide unrestricted visual search, which is something real driving does not permit. During on-road tasks, drivers need to devote some of their visual search and attention workload to inform the steering task to keep track of the road and to maintain appropriate lateral displacement. For example, when approaching a curve, up to 30% of the eye fixations are located at the tangent point (Laya, 1991) and once the driver has entered the curve the tangent point becomes the main focus of attention, with fixations increasing from 30 to up to 80% (Land and Lee, 1994). Also drivers need to frequently check the rear view mirrors for possible hazards as well as gather information from the different displays on the dashboard.

The current study used a hazard perception dual task paradigm, which included video-based traffic simulations with greater external validity than the standard hazard perception tests. The primary task was detecting and identifying hazardous traffic scenarios in front of the car and also in the three rear view mirrors. The secondary task required the participants to keep track of a moving target that was superimposed over the front view traffic scenarios. The objective of this study was firstly to compare the hazard perception skills of young drivers with those of experienced drivers using this demanding dual task that may prompt the participants to prioritise their workload between the primary and secondary tasks. Secondly, we wanted to assess the effect of brief video-based road commentary training trials on participants' hazard perception performance. Road commentary training has been found to decrease hazard perception reaction times both when performed during real driving (Mills et al., 1998) and while watching video-based traffic scenarios (cited in Horswill and McKenna, 2004). The training requires the participants either to provide a verbal running commentary which points out any hazards they can detect and how they would respond to them, or to listen to an expert providing the commentary for them. This training technique seems to encourage drivers to actively search for hazards and may improve their situation awareness and lead to a better appreciation of the risks involved (McKenna et al., 2006).

2. Method

2.1. Participants

Thirty-two New Zealand drivers volunteered for this study. Twenty-four of the recruited participants (19 females and 5 males)